



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
NATIONAL MARINE FISHERIES SERVICE  
Northwest Region  
7600 Sand Point Way N.E., Bldg. 1  
Seattle, WA 98115

Refer to:  
2003/00077

August 22, 2003

Mr. Lawrence C. Evans  
Portland District, Corps of Engineers  
CENWP-OP-GP (Mr. Ron Marg)  
P.O. Box 2946  
Portland, OR 97208-2946

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat Consultation on Issuance of a Permit for the Recreational Fishing Platform, Oregon Department of Fish and Wildlife, Nehalem River Basin, Tillamook County, Oregon (Corps No. 200200552)

Dear Mr. Evans:

Enclosed is a biological opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of issuing a permit under section 404 of the Clean Water Act to the Oregon Department of Fish and Wildlife to construct a recreational fishing platform and complete habitat restoration activities in the Nehalem River basin, Tillamook County, Oregon (Corps No. 200200552). In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of Oregon Coast coho salmon. As required by section 7 of the ESA, NOAA Fisheries included reasonable and prudent measures with nondiscretionary terms and conditions are necessary to minimize the impact of incidental take associated with this action.

This document also serves as consultation on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations (50 CFR Part 600).

Please direct any questions regarding this consultation to Robert Anderson of my staff in the Oregon Habitat Branch at 503.231.2226.

Sincerely,

D. Robert Lohn  
Regional Administrator



# Endangered Species Act - Section 7 Consultation Biological Opinion

&


## Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Oregon Department of Fish and Wildlife Recreational Fishing Platform,  
Nehalem River Basin, Tillamook County, Oregon  
(Corps No. 200200552)

Agency: U.S. Army Corps of Engineers

Consultation  
Conducted By: NOAA's National Marine Fisheries Service,  
Northwest Region

Date Issued: August 22, 2003

Issued by:   
D. Robert Lohn  
Regional Administrator

Refer to: 2003/00077

## TABLE OF CONTENTS

1. INTRODUCTION .....	<a href="#"><u>1</u></a>
1.1 Background and Consultation History .....	<a href="#"><u>1</u></a>
1.2 Proposed Action .....	<a href="#"><u>2</u></a>
1.2.1 Fishing Platform and Retaining Wall .....	<a href="#"><u>2</u></a>
1.2.2 Conservation Measures .....	<a href="#"><u>2</u></a>
1.2.3 Habitat Restoration .....	<a href="#"><u>2</u></a>
1.3 Description of the Action Area .....	<a href="#"><u>2</u></a>
2. ENDANGERED SPECIES ACT .....	<a href="#"><u>3</u></a>
2.1 Biological Opinion .....	<a href="#"><u>3</u></a>
2.1.1 Biological Information .....	<a href="#"><u>3</u></a>
2.1.2 Evaluating Proposed Actions .....	<a href="#"><u>4</u></a>
2.1.3 Biological Requirements .....	<a href="#"><u>5</u></a>
2.1.4 Environmental Baseline .....	<a href="#"><u>5</u></a>
2.1.5 Analysis of Effects .....	<a href="#"><u>6</u></a>
2.1.5.1 Effects of Proposed Action .....	<a href="#"><u>6</u></a>
2.1.5.2 Cumulative Effects .....	<a href="#"><u>10</u></a>
2.1.6 Conclusion .....	<a href="#"><u>10</u></a>
2.1.7 Conservation Recommendations .....	<a href="#"><u>11</u></a>
2.1.8 Reinitiation of Consultation .....	<a href="#"><u>11</u></a>
2.2 Incidental Take Statement .....	<a href="#"><u>11</u></a>
2.2.1 Amount or Extent of Take .....	<a href="#"><u>12</u></a>
2.2.2 Reasonable and Prudent Measures .....	<a href="#"><u>12</u></a>
2.2.3 Terms and Conditions .....	<a href="#"><u>13</u></a>
3. MAGNUSON-STEVENSON ACT .....	<a href="#"><u>17</u></a>
3.1 Background .....	<a href="#"><u>17</u></a>
3.2 Identification of EFH .....	<a href="#"><u>17</u></a>
3.3 Proposed Action .....	<a href="#"><u>18</u></a>
3.4 Effects of Proposed Action .....	<a href="#"><u>18</u></a>
3.5 Conclusion .....	<a href="#"><u>18</u></a>
3.6 EFH Conservation Recommendations .....	<a href="#"><u>18</u></a>
3.7 Statutory Response Requirement .....	<a href="#"><u>18</u></a>
3.8 Supplemental Consultation .....	<a href="#"><u>19</u></a>
4. LITERATURE CITED .....	<a href="#"><u>20</u></a>
4. LITERATURE .....	<a href="#"><u>19</u></a>

## **1. INTRODUCTION**

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1544), as amended, establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service NOAA's National Marine Fisheries Service (NOAA Fisheries), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. This biological opinion (Opinion) is the product of an interagency consultation pursuant to section 7(a)(2) of the ESA and implementing regulations found at 50 CFR 402.

The analysis also fulfills the essential fish habitat (EFH) requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

### **1.1 Background and Consultation History**

On May 2, 2003, NOAA Fisheries received a letter from the U.S. Army Corps of Engineers (Corps) requesting formal consultation pursuant to section 7(a)(2) of the ESA, and EFH consultation pursuant to section 305(b)(2) of the MSA for issuance of a permit by the Corps under section 404 of the Clean Water Act to authorize construction of a recreational fishing platform with a 68-foot retaining wall by the Oregon Department of Fish and Wildlife (ODFW) in the Nehalem River basin, Tillamook County, Oregon. Enclosed with the letter was a biological assessment (BA) describing the proposed action and potential effects that may result from project implementation. In the BA, the Corps determined that the proposed action was "likely to adversely affect" (LAA) Oregon Coast (OC) coho salmon (*Oncorhynchus kisutch*), an ESA-listed species.

This biological opinion (Opinion) considers the potential effects of the proposed action on OC coho salmon, which occur in the proposed action area. OC coho salmon were listed as threatened under the ESA on August 10, 1998 (63 FR 42587) and protective regulations were issued on July 10, 2000 (65 FR 42422). The objective of this Opinion is to determine whether the proposed action is likely to jeopardize the continued existence of OC coho salmon. This consultation is conducted pursuant to section 7(a)(2) of the ESA and its implementing regulations, 50 CFR 402.

## **1.2 Proposed Action**

### **1.2.1 Fishing Platform and Retaining Wall**

The proposed action is issuance of a permit by the Corps under section 404 of the Clean Water Act to authorize discharge of fill materials into waters of the United States by the ODFW to construct a recreational fishing platform with a concrete retaining wall at river mile 11 in the north fork of the Nehalem River. The platform would be placed atop a new concrete retaining wall retaining wall that would measure 68 feet long, 10 feet wide, and four feet high. The top section of the retaining wall would be covered with asphalt concrete pavement. Approximately 80 cubic yards (CY) of fill material would be placed behind the retaining wall below ordinary high water, filling approximately 1360 ft<sup>2</sup> of streambank and eliminating existing riparian vegetation, to construct the concrete retaining wall.

### **1.2.2 Conservation Measures**

The ODFW proposes to conduct all in-water work, defined as all work below top-of-bank, within the recommended in-water work window by the ODFW (July 1 through September 15) (ODFW 2002). A temporary cofferdam would be installed to isolate the construction site from the river, and to isolate the area upstream and downstream of the culvert during removal. After construction and fish passage remediation activities are completed, the cofferdams would be removed.

### **1.2.3 Habitat Restoration**

The ODFW proposes to remove a culvert to restore fish passage and stream functions on a tributary to God's Valley Creek, a tributary to the north fork of the Nehalem River at river mile 13.5 that is a passage barrier to fish. Removal of the culvert would provide approximately 1500 linear feet of stream for rearing habitat. The ODFW also proposed to dismantle the remaining pieces of an electric fish barrier that was operated by the Nehalem hatchery. The structure is approximately 60 feet long and 20 feet wide, and spans the entire width of the north fork of the Nehalem River 150 upstream of the proposed retaining wall. The ODFW also would plant a 280-foot upland streamside area with native riparian vegetation upstream of the platform construction site.

## **1.3 Description of the Action Area**

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area (project area) involved in the proposed action (50 CFR 402.02). For this consultation, the action area includes all riverine habitats, including any channel migration zones, accessible to OC coho salmon in the Nehalem River from RM 10.75 to RM 11.15, and in the area within 0.25 mile downstream of the proposed habitat restoration work on a tributary to God's Valley Creek, a tributary of the Nehalem River at RM 13.5.

## 2. ENDANGERED SPECIES ACT

### 2.1 Biological Opinion

#### 2.1.1 Biological Information

OC coho salmon use the action area for spawning, rearing, and migration. The timing of life history events of OC coho salmon in the Nehalem River basin is summarized in Table 1.

**Table 1.** OC Coho Salmon Life History in the Nehalem River Basin (Weitkamp 1995, Sheahan 2002).  
Light shading represents low-level abundance, dark shading represents peak abundance.

	J	F	M	A	M	J	J	A	S	O	N	D
<b>River Entry</b>												
<b>Spawning</b>												
<b>Intragravel Development</b>												
<b>Juvenile Rearing</b>												
<b>Juvenile Out-migration</b>												

Estimated escapement of coho salmon in Coastal Oregon was about 1.4 million fish in the early 1900s, with harvest of nearly 400,000 fish (Weitkamp *et al.* 1995). Abundance of wild OC coho salmon declined during the period from about 1965 to 1975 and then fluctuated at low levels (Nickelson *et al.* 1992). Lichatowich (1989) concluded that production potential (based on stock recruit models) for OC coho salmon in coastal Oregon rivers was only about 800,000 fish, and associated this decline with a reduction in habitat capacity of nearly 50%. Recent estimates of wild spawner abundance in this evolutionarily significant unit (ESU) has ranged from about 16,500 adults in 1990, to near 60,000 adults in 1996, and an estimated 35,000 adult coho in 2001 (ODFW 2002). The current status of OC coho salmon, based upon their risk of extinction, has not significantly improved since the species was listed.

Estimated spawning populations for naturally-produced coho in the Nehalem River basin averaged 2672 adults from 1990 through 2001. These results are summarized in Table 2.

**Table 2.** Estimated spawning populations for naturally-produced coho in the Nehalem River basin (Jacobs *et al.* 2001, ODFW 2002).

Year:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Estimated Nehalem River Basin Population:	1552	3975	1268	2265	2007	1463	1057	1173	1190	3713	4575	7825

Based on survey data collected by ODFW from 1950 to 1998 in the Nehalem River basin, estimated adult coho densities ranged from 29 fish m<sup>-2</sup> in 1950, to five fish m<sup>-2</sup> in 1998 (PSU 1999). Estimated juvenile coho densities are 0.00 fish m<sup>-2</sup> to 0.72 fish m<sup>-2</sup> with an average of 0.14 fish m<sup>-2</sup> for 1998 and 1999 (Rodgers 2001). The Nehalem River population is the fifth most productive watershed in the geographic range of the OC coho ESU (ODFW 2002). These data show that total escapement of wild OC coho salmon, and the contribution of the Nehalem River to that total, varies widely from year to year. Nonetheless, the Nehalem River is generally among the most productive watersheds within the ESU and, in 2001, accounted for 22% of the naturally-spawning OC coho salmon population.

### 2.1.2 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR 402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations and when appropriate combines them with the Habitat Approach (NOAA Fisheries 1999): (1) Consider the biological requirements of the listed species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species; and (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the effects of the environmental baseline, and any cumulative effects, and considering measures for survival and recovery specific to other life stages. In completing this step of the analysis, NOAA Fisheries determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the ESA-listed species. If either or both are found step 5 occurs. In step 5, NOAA Fisheries may identify reasonable and prudent alternatives for the action that avoid jeopardy, if any exist.

The fourth step above requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area (*i.e.*, effects on essential habitat features). The second part focuses on the species itself. It describes the action's effects on individual fish, or populations, or both, and places these effects in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the questions of whether the proposed action is likely to jeopardize a listed species' continued existence

### **2.1.3 Biological Requirements**

The first step in the methods NOAA Fisheries uses for applying the ESA section 7(a)(2) to listed salmon is to define the species' biological requirements that are most relevant to each consultation. NOAA Fisheries also considers the current status of the listed species, taking into account population size, trends, distribution and genetic diversity. To assess to the current status of the listed species, NOAA Fisheries starts with the determinations made in its decision to list the species for ESA protection and also considers new data available that is relevant to the determination.

The biological requirements are population characteristics necessary for OC coho salmon to survive and recover to naturally-reproducing population levels, at which time protection under the ESA would become unnecessary. Adequate population levels must safeguard the genetic diversity of the listed stock, enhance its capacity to adapt to various environmental conditions, and allow it to become self-sustaining in the natural environment.

For actions that affect freshwater habitat, NOAA Fisheries usually describes the habitat portion of a species' biological requirements in terms of a concept called properly functioning condition (PFC). PFC is defined as the sustained presence of natural,<sup>1</sup> habitat-forming processes in a watershed that are necessary for the long-term survival of the species through the full range of environmental variation (NOAA Fisheries 1999). PFC, then, constitutes the habitat component of a species' biological requirements. OC coho salmon survival in the wild depends upon the proper functioning of ecosystem processes, including habitat formation and maintenance. Restoring functional habitats depends largely on allowing natural processes to increase their ecological function, while at the same time removing adverse effects of current practices. For this consultation, the biological requirements are improved habitat characteristics that would function to support successful adult migration and holding, spawning, incubation, migration, over-wintering, juvenile out-migration, and smoltification.

### **2.1.4 Environmental Baseline**

In step two of NOAA Fisheries' analysis, it evaluates the relevance of the environmental baseline in the action area. Regulations implementing section 7 of the ESA (50 CFR 402.02) define the environmental baseline as the past and present effects of all Federal, state, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated effects of all proposed Federal projects in the action area that have undergone section 7 consultation, and the effects of state and private actions that are contemporaneous with the consultation in progress.

---

<sup>1</sup> The word "natural" in this definition is not intended to imply "pristine," nor does the best available science lead us to believe that only pristine wilderness will support salmon.



Land uses in the action area include rural-residential, agricultural, commercial-industrial, and commercial forestry. Riparian areas and stream channels in the action area have been damaged by development activities related to these land uses, as well as by the use of splash dams, and instream gravel mining throughout the watershed (FEMAT 1993, Botkin *et al.* 1995, OCSRI 1997). Habitat changes that have contributed to the decline of OC coho in the action area include: (1) Reduced biological, chemical, and physical connectivity between streams, riparian areas, flood plains, and uplands; (2) elevated fine sediment yields; (3) reduced in-stream large woody debris; (4) loss or degradation of riparian vegetation; (5) altered stream channel morphology; (6) altered base and peak stream flows; and (7) fish passage impediments (OCSRI 1997). The Nehalem River is on the Oregon Department of Environmental Quality (ODEQ) 303(d) List of Water Quality Limited Water Bodies for temperature.

NOAA Fisheries concludes that not all of the biological requirements of the listed species within the action area are being met under current conditions. Based on the best available information on the status of OC coho salmon, including population status, trends, and genetics, and the environmental baseline conditions within the action area, significant improvement in habitat conditions is needed to meet the biological requirements of OC coho salmon for survival and recovery.

## **2.1.5 Analysis of Effects**

### **2.1.5.1 Effects of Proposed Action**

In step three of NOAA Fisheries' jeopardy analysis, it evaluates the effects of proposed actions on listed species and seeks to answer the question of whether the species can be expected to survive with an adequate potential for recovery if those actions go forward.

In the short term, the proposed action is likely to temporarily displace, injure or kill rearing juvenile OC coho salmon due to cofferdam installation and removal, fish removal and handling, and increased TSS. In the long term, the recreational fishing platform may result in increased fishing pressure on OC coho salmon, and the concrete retaining wall that supports the fishing platform would modify approximately 1360 ft<sup>2</sup> of juvenile rearing habitat in the north fork of the Nehalem River (river mile 11.0). The proposed habitat restoration activities would provide approximately 1500 linear feet of rearing habitat, improve fish passage and river conditions in the north fork of the Nehalem River, and enhance riparian functions.

#### Construction Activities

In-water construction activities (*e.g.*, retaining wall construction, culvert removal) would occur within cofferdams. The effects of cofferdam installation and removal, fish removal and handling, and use of construction equipment are discussed below.

#### Fish Harassment

Fish may be killed, or more likely temporarily displaced, by in-water work activities. Aspects of the proposed action most likely to injure or kill OC coho salmon are the isolation of the in-water

work area, and fish removal and handling. Although in-water work area isolation is a conservation measure intended to minimize adverse effects from in-stream construction activities to fish present in the work isolation area, some fish may be captured, handled, and released. Capturing and handling fish causes physiological stress, though overall effects of the procedure are generally short-lived if appropriate precautions are exercised. The primary factors controlling the likelihood of stress and death from handling are differences in water temperatures (between the stream and transfer containers), dissolved oxygen concentrations, the amount of time that fish are held out of the water, and the extent of physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18°C or if dissolved oxygen concentration is below saturation.

The in-water work period recommended by the ODFW (July 1 to September 15) of a given year, and the proposed fish removal methods, which require supervision by a fishery biologist experienced with capture and removal of ESA-listed species and work area isolation, are likely to minimize the adverse effects from work area isolation and fish handling.

#### Water Quality – Total Suspended Solids and Turbidity

Turbidity is defined as a measurement of relative clarity due to an increase in dissolved (e.g., tannic acid) or undissolved particles (*i.e.*, suspended solids). In-water construction activities (e.g., retaining wall construction and compensatory mitigation) are likely to temporarily increase turbidity. Potential effects of increased turbidity on OC coho salmon include, but are not limited to: (1) Reduction in feeding rates and growth; (2) increased mortality; (3) physiological stress; (4) behavioral avoidance; (5) reduction in macroinvertebrate populations; and (6) temporary beneficial effects. Potential beneficial effects of increased turbidity on salmonids include increased cover, reduced predation from fish and birds, and improved survival.

Turbidity, at moderate levels, can reduce primary and secondary productivity, and at high levels, can interfere with feeding and injure or kill adult and juvenile fish (Spence *et al.* 1996, Bjornn and Reiser 1991). Other behavioral effects on fish, such as gill flaring and feeding changes, have been observed in response to pulses of suspended sediment (Berg and Northcote 1985). Fine, redeposited sediments also have the potential to reduce primary and secondary productivity (Spence *et al.* 1996), and to reduce incubation success and interstitial rearing space for juvenile salmonids (Bjornn and Reiser 1991).

Salmonid fishes move laterally and downstream to avoid turbid plumes (Sigler *et al.* 1984, Lloyd 1987, Servizi and Martens 1991). Juvenile salmonid fishes tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, except when the fish must traverse these streams along migration routes (Lloyd *et al.* 1987). In addition, a potential positive effect is providing refuge and cover from predation; fish that remain in turbid waters experience a reduction in predation from piscivorous fish and birds (Gregory and Levings 1998). In habitats with intense predation pressure, this provides a beneficial trade-off (e.g., enhanced survival) for the cost of potential physiological effects (e.g., reduced growth).

Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects (Newcombe and MacDonald 1991). Salmonid fishes have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with floods, and are adapted to such exposures. Adult and larger juvenile salmonid fishes appear to be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjornn and Reiser 1991). However, chronic exposure can cause physiological stress that can increase energy required for maintenance of the fish and reduce feeding and growth (Redding *et al.* 1987, Lloyd 1987, Servizi and Martens 1991).

Increased TSS can adversely affect filter-feeding macroinvertebrates and fish feeding. At concentrations of 53 to 92 ppm (24 hours) macroinvertebrate populations were reduced (Gammon 1970). Concentrations of 250 ppm (one hour) caused a 95% reduction in feeding rates in juvenile coho salmon (Noggle 1978). Concentrations of 1200 ppm (96 hours) killed juvenile coho salmon (Noggle 1978). Concentrations of 53.5 ppm (12 hours) caused physiological stress and changes in behavior in coho salmon (Berg 1983).

In-water construction activities that occur without isolation of the work area are likely to increase turbidity and adversely affect OC coho salmon. Activities that occur within the cofferdams and above top-of-bank are less likely to increase turbidity. Changes in turbidity may persist for a period of approximately 1 to 10 hours. In-water construction activities with a short duration (*i.e.*,  $\leq 15$  minutes) are likely to increase turbidity for a short distance downstream of the proposed weir-intake construction site. Sustained disturbances over a period of several hours may increase turbidity for up to a mile downstream. Repeated chronic pulses of turbidity that persist over a period of days or weeks may lead to reach-scale displacement of rearing OC coho salmon, reducing rearing success.

#### Effects of Increased Fishing Pressure

Construction of the fishing platform likely would increase fishing pressure on OC coho salmon. The most likely effects to OC coho salmon are injury, expenditure of energy, stress, asphyxiation, and mortality. These effects are likely to be minimized for the following reasons: (1) ODFW cannot exceed the harvest management limits for listed OC coho salmon set by the Pacific Fisheries Management Council (PFMC); (2) section 7 consultation on the PFMC Pacific salmon management plan concluded that the PFMC Pacific salmon management plan would not jeopardize listed Pacific salmon and steelhead (NOAA Fisheries 1998); (3) the freshwater fisheries on the Oregon coast is 10% (on average) of the wild OC coho salmon return; (4) no retention of wild OC coho is permitted; (5) catch and release mortality of wild OC coho salmon is approximately 10%; (6) the target species are hatchery coho salmon; and (7) run timing of hatchery and wild OC coho salmon are generally separated temporally by several weeks.

#### Effects of Bank Hardening

Significant elements of natural riparian and stream processes can be affected by stream-bank hardening (*e.g.*, bulkheads) (Bolton and Shellberg 2001). Bank hardening not only modifies the

streambed and bank but, as its primary purpose, stops natural processes that maintain a functioning riparian stream system.

As erosive forces affect different locations in a stream, and bank hardening occurs in response, the stream eventually may attain a continuous fixed alignment lacking habitat complexity (USACE 1977). Bank hardening may shift erosion points either upstream, due to headcutting, or downstream, due to transfer of stream energy. Bank hardening can also increase stream velocities, contributing to channel incision and streambank failure.

Bank hardening results in site characteristics that limit suitability for fish at various life stages (Beamer and *Henderson* 1998, Peters *et al.* 1998, Li *et al.* 1984, North *et al.* 2002), or perpetuates detrimental conditions that may restrict or limit fish production (Beamer and *Henderson* 1998, Li *et al.* 1984). Bank hardening changes the hydraulics, substrate, and available food and cover for fish at stream sites where it is used. It can disrupt flows, reduce food delivery and create unfavorable swimming conditions for smaller fish (Michny and Deibel 1986, Schaffter *et al.* 1983). These effects can reduce the suitability of the habitat for salmonids, and are difficult to mitigate. Alteration of the streambanks and streambed under the proposed action would likely lead to habitat effects similar to those described above.

#### Habitat Restoration

Regarding the plantings beside the construction site, limited riparian functions would be provided until the plantings are fully established over at 15 years. Overall, the proposed riparian plantings likely would improve riparian habitat structure and its associated functions in the project area.

The proposed habitat restoration work includes the removal of a culvert on a tributary to God's Valley Creek, a tributary to the north fork of the Nehalem River at river mile 13.5 to improve fish passage. Culvert removal would require temporary disturbance of in-stream habitat and likely would cause short-term adverse effects similar to those described above for fish harassment and water quality (discussed above). Culvert removal would restore fish access to approximately 1500 linear feet of stream for rearing habitat. The dismantling of an electric fish barrier that spans the entire width of the north fork of the Nehalem River 25 feet upstream of the proposed retaining wall would improve fish passage and river conditions.

In-water work would occur during recommended in-water work period, July 1 to September 15. The proposed fish removal includes supervision by a fishery biologist experienced with ESA-listed species and work area isolation, are likely to minimize the adverse effects from the proposed habitat restoration.

#### Construction Equipment

As with all construction activities, accidental release of fuel, oil, and other contaminants may occur. Operation of mechanized equipment requires the use of fuel, lubricants, *etc.*, which if spilled into a waterbody could injure or kill aquatic organisms. Petroleum-based contaminants

(such as fuel, oil, and some hydraulic fluids) contain PAHs which can cause acute toxicity to salmonid fishes at high levels of exposure and can also cause chronic lethal as well as acute and chronic sublethal effects to aquatic organisms (Neff 1985).

#### **2.1.5.2 Cumulative Effects**

Cumulative effects are defined in 50 CFR 402.02 as “those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.”

NOAA Fisheries is not aware of any specific future non-federal activities within the action area that would cause greater effects to listed species than presently occurs. The action area includes significant tracts of private and state lands. Land use on these non-federal lands include rural development, agricultural, and commercial forestry. Chemical fertilizers or pesticides are used on many of these lands, but no specific information is available regarding their use. Furthermore, NOAA Fisheries generally does not consider the rules governing timber harvests, agricultural practices, and rural development on non-federal lands within Oregon to be sufficiently protective of watershed, riparian, and stream habitat functions to support the survival and recovery of listed species. Therefore, these habitat functions likely are at risk due to future activities on non-federal forest lands within the basin.

Non-federal activities within the action area are expected to increase due to a projected 34% increase in human population by the year 2020 in Oregon (Oregon Department of Administrative Services 1999). Thus, NOAA Fisheries assumes that future private and state actions will continue within the action area, increasing as population density rises.

#### **2.1.6 Conclusion**

NOAA Fisheries concludes that the issuance of a permit by the Corps to authorize construction of a recreational fishing platform by ODFW is not likely to jeopardize the continued existence of OC coho salmon. In reaching this conclusion, NOAA Fisheries used the best available scientific and commercial data to apply its jeopardy analysis, and analyzed the effects of the proposed action on the biological requirements of the species relative to the environmental baseline, together with cumulative effects. This conclusion is based in part on incorporation of conservation measures into the proposed action that would avoid or minimize adverse effects to listed coho and their habitat by: (1) Limiting all in-water construction work activities to the in-water work period between July 1 and September 15, when the most vulnerable life stages (0+ age class) of listed coho salmon are least likely to be present in the action area; (2) conducting fish removal activities under the supervision of a fisheries biologist experienced with ESA-listed fish and work area isolation; (3) completing habitat restoration that would improve fish passage; and (4) enhance riparian functions and river conditions.

### **2.1.7 Conservation Recommendations**

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitats, or to develop additional information. The following conservation recommendation is consistent with these obligations, and therefore should be carried out by the Corps for lower Columbia River dredging activities conducted under Corps authorization:

The Corps should require applicants to mitigate for actions that adversely effect riparian or riverine habitat functions using the Corps guidance on compensatory mitigation projects for aquatic resource impacts under its regulatory program pursuant to section 404 of the Clean water Act and section 10 of the Rivers and Harbors act, and include these mitigation measures as part of the consultation request.

For the NOAA Fisheries to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed salmon and their habitats, NOAA Fisheries requests notification of any actions leading to the achievement of the conservation recommendation.

### **2.1.8 Reinitiation of Consultation**

This concludes formal consultation on these actions in accordance with 50 CFR 402.14(b)(1). Reinitiation of consultation is required: (1) If the amount or extent of incidental take is exceeded; (2) the action is modified in a way that causes an effect on the listed species that was not previously considered in the biological assessment and this Opinion; (3) if the culvert and weir removal mitigation measure are not completed by September 15, 2003; (4) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; or (5) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

## **2.2 Incidental Take Statement**

The ESA at section 9 [16 USC 1538] prohibits take of endangered species. The prohibition of take is extended to threatened anadromous salmonids by section 4(d) rule [50 CFR 223.203]. Take is defined by the statute as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” [16 USC 1532(19)] Harm is defined by regulation as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering.” [50 CFR 222.102] Harass is defined as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited

to, breeding, feeding, or sheltering.” [50 CFR 17.3] Incidental take is defined as “takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant.” [50 CFR 402.02] The ESA at section 7(o)(2) removes the prohibition from any incidental taking that is in compliance with the terms and conditions specified in a section 7(b)(4) incidental take statement [16 USC 1536].

### **2.2.1 Amount or Extent of Take**

NOAA Fisheries anticipates that the proposed action covered by this Opinion is reasonably certain to result in incidental take of juvenile OC coho as a result of: (1) In-water work activities (*e.g.*, cofferdam installation and removal, culvert removal, weir removal); (2) streambank hardening; (3) temporary increases in total suspended solids; and (4) fish removal and handling. Harm is defined as an act which actually injures or kills wildlife from significant habitat modifications by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Take in the form of harm is likely to result from coffer dam installation and removal, culvert removal, weir removal, and streambank hardening. Take in association with water quality changes is largely unquantifiable, although reasonably certain based on the analysis in section 2.1.3. The amount of take from coffer dam installation and removal, culvert removal, weir removal, and streambank hardening shall not exceed 50 juvenile OC coho salmon. Take resulting from the capture and release or killing of listed OC coho salmon is limited to take resulting from activities undertaken as described in this Opinion that occur in the isolated, in-water work area during the approved in-water work period (July 1 through September 15). No more than five juvenile OC coho salmon may be killed.

The extent of take for this opinion is limited to take resulting from activities undertaken as described in this Opinion that occur in the action area, which includes all riverine habitats and accessible to OC coho salmon in the Nehalem River from RM 10.75 to RM 11.15, the channel migration zone, and an area within 0.25 mile (downstream) downstream of the proposed habitat restoration work on a tributary to God’s Valley Creek, a tributary of the Nehalem River at RM 13.5.

### **2.2.2 Reasonable and Prudent Measures**

NOAA Fisheries believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of the above species.

The Corps shall ensure that:

1. The amount and extent of incidental take from construction activities is minimized by ensuring that in-water work is limited to the time when effects to OC coho salmon in the Nehalem basin would be minimized.
2. The amount and extent of incidental take from construction activities in or near watercourses by ensuring that an effective spill, prevention, containment, and control

plan is developed, implemented, and maintained to avoid or minimize point-source pollution both into and within watercourses over the short term and the long term.

3. The amount and extent of incidental take is minimized by completing the habitat restoration work in a timely manner and with the minimal disturbance required to complete the work.
4. The reasonable and prudent measures, in-water work, habitat restoration work, and near-shore and riparian habitats are monitored and evaluated both before and during project implementation.

### **2.2.3 Terms and Conditions**

To be exempt from the prohibitions of section 9 of the ESA, Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above for each category of activity.

1. To implement reasonable and prudent measure #1 (in-water work), the Corps shall ensure that:
  - a. All work below top-of-bank is completed within the recommended in-water work period (July 1 through September 15). Any adjustments to the in-water work period must be approved in writing by NOAA Fisheries.
  - b. All water intakes used for the project, to include pumps used to isolate an in-water work area, will have a fish screen installed, operated, and maintained according to NOAA Fisheries' juvenile fish screen criteria for fish available at: <http://www.nwr.noaa.gov/1hydroweb/hydroweb/ferc.htm>
  - c. Before and intermittently during de-watering to isolate an in-water work area, an attempt must be made to capture and release fish from the isolated area to minimize risk of harm or killing.
    - i. Complete transfers using a sanctuary net that holds water during transfer to prevent the added stress of an out-of-water transfer.
    - ii. Describe any capture and release effort in a post-project report, including the name and address of the supervisory fish biologist, methods used to isolate the work area and minimize disturbances to ESA-listed species, stream conditions before and following placement and removal of barriers, the means of fish removal, the number of fish removed by species, the condition of all fish released, and any incidence of observed injury or mortality.
    - iii. Electroshocking is not authorized under this Opinion.
  - d. If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens



to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement reasonable and prudent measure #2, (habitat restoration), the Corps shall ensure that:
  - a. The proposed fish passage remediation (*e.g.*, culvert removal) is completed before, or concomitantly with, construction of the retaining wall.
  - b. In-stream restoration activities (*e.g.*, culvert removal) are carried out in a manner that does not create head cutting or down cutting of the stream channel.
  - c. Any rock used is non-angular (*e.g.*, gravel, cobbles).
  - d. A plan for riparian planting is submitted to the Corps and NOAA Fisheries before completion of riparian restoration work that includes:
    - i. selection of native woody vegetation species for riparian planting;
    - ii. inspect and, if necessary, replace failed plantings to achieve 100% survival at the end of the first year, and 80% survival or 80% coverage (including both plantings and natural recruitment) of a self-maintaining (*i.e.*, no watering required) vegetative community after five years;
    - iii. Control invasive non-native vegetation without the use of herbicides..
    - iv. Protect plantings from wildlife damage and other harm.
    - v. Provide the Corps annual progress reports.
  - g. No fertilizer will be applied on the ground surface within 50 feet of any stream.
3. To implement reasonable and prudent measure #3, (pollution and erosion control), the Corps shall ensure that:
  - a. A pollution and erosion control plan is prepared and carried out to prevent pollution related to construction operations. The plan must be available for inspection on request by NOAA Fisheries.
  - b. Effective erosion control measures are in-place at all times during the contract. Applicable erosion control measures will be installed before any on-the-ground construction activities. Erosion control structures will be maintained throughout the life of the contract, and removed upon completion of construction as appropriate.
    - i. Erosion control measures will be applied to all areas of bare soil within seven days of exposure within 150 feet of any natural waterbody. All other areas will be stabilized within 14 days of exposure.
    - ii. All erosion control devices will be inspected throughout the construction period to ensure that they are working adequately. Should a control measure not function effectively, the control measure will be immediately repaired or replaced. Additional erosion controls will be installed as necessary.

- iii. In the event that soil erosion and sediment resulting from construction activities is not effectively controlled, the Corps will limit the amount of disturbed area to that which can be adequately controlled.
    - iv. All equipment that is used for in-stream work will be cleaned prior any in-water work. All mechanized equipment will work from top-of-bank. External oil and grease will be removed from excavator arms and buckets before use below top-of-bank.
    - v. Materials removed during excavation will only be placed in upland locations at least 25 feet from top-of-bank to ensure that excavated materials do not re-enter the active channel. Conservation of topsoil (removal, storage and reuse) is encouraged.
    - vi. Untreated wash and rinse water will not be discharged into any natural waterbody. Discharge from any pumping will be into a discharge structure to reduce concentrated velocities and minimize scour and erosion.
  - c. Vehicles operated within 150 feet of top-of-bank are free of fluid leaks. Vehicles will be examined daily for leaks.
  - d. Vehicle staging, maintenance, refueling, and fuel storage areas, will be at least 150 feet from top-of-bank.
  - e. At the end of each work shift, vehicles will be stored at least 150 feet (horizontal distance) from top-of-bank.
  - f. Refueling of all equipment occurs at least 150 feet from the active channel.
4. To implement reasonable and prudent measure #4, above, (monitoring), the Corps shall ensure that:
- a. Within 120 days of completion of construction activities, a report summarizing effects of the activities on listed fish and their habitat is provided to NOAA Fisheries. This report will discuss:
    - i. Implementation of conservation measures proposed by the ODFW, including the success or failure of conservation measures, actions taken to correct failures, and confirmation that the proposed retaining wall was built as proposed.
    - ii. Specific methods used to minimize sediment mobilization and increases in turbidity.
    - iii. Stream conditions before and following in-water work.
    - iv. Extent, duration, and frequency of any turbidity plumes related to project activities.
    - v. Measures taken to isolate the in-water work area.
    - vi. Fish removal and handling methods, to include the name, phone number, and affiliation of the biologist conducting fish removal and handling.
    - vii. Any observed injury and/or mortality of fish resulting from project implementation.

- b. Following the completion of riparian plantings, the Corps shall provide NOAA Fisheries annually with a report by December 31 that describes the success of plantings required under reasonable and prudent measure #4 (near-shore and riparian habitats). The report should describe plant survival and coverage, and indicate any replantings completed during the preceding 12 month-period. The report will include photo documentation. This requirement will be satisfied upon demonstration that 80% survival of plantings or 80% coverage (including both plantings and natural recruitment) of a self-maintaining (*i.e.*, no watering required) vegetative community has been achieved after a minimum of five years.
- c. Within 120 days of completion of in-stream habitat restoration measures, a report summarizing results is provided to NOAA Fisheries. This report will discuss:
  - i. Final design plans, work methods used, actions taken to correct problems, and effectiveness of the work in achieving the restoration objectives.
  - ii. Stream conditions, to include in-stream flows (*e.g.*, discharge, velocities, and depth), stream channel profile, and streambank and streambed condition, before and following in-water work.
  - iii. Photo-documentation of restoration site before and after culvert removal from at least two fixed points.
  - iv. Specific methods used to minimize sediment mobilization and increases in turbidity.
  - v. Extent, duration, and frequency of any turbidity plumes related to project activities.
  - vi. Measure taken to isolate the in-water work area.
  - vii. Fish removal and handling methods, to include the name, phone number, and affiliation of the biologist conducting fish removal and handling.
  - viii. Any observed injury and/or mortality of fish resulting from project implementation.
- d. An annual report is submitted to NOAA Fisheries for a period of three years that includes the information required in 4.c.ii and 4.c.iii above. Submit
- e. Submit all monitoring reports to:
  - National Marine Fisheries Service
  - Habitat Conservation Division
  - Attn: 2003/00077**
  - 525 NE Oregon Street, Suite 500
  - Portland, OR 97232

### 3. MAGNUSON-STEVENSON ACT

#### 3.1 Background

Pursuant to the MSA:

- NOAA Fisheries must provide conservation recommendations for any Federal or state action that would adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects on EFH.

#### 3.2 Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: Chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California,

except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

### **3.3 Proposed Action**

The proposed action is detailed above in section 1.2 of this document. For this consultation, the action area includes all riverine habitats (including any channel migration zones) accessible to OC coho salmon in the Nehalem River from RM 10.75 to RM 11.15, and an area within 0.25 mile (downstream) downstream of the proposed habitat restoration work on a tributary to God's Valley Creek, a tributary of the Nehalem River at RM 13.5. This area has been designated as EFH for various life stages of chinook and coho salmon.

### **3.4 Effects of Proposed Action**

The proposed action is likely to adversely affect juvenile rearing and migration habitat and water quality for chinook and coho salmon, and would restore approximately 1500 feet of rearing habitat.

### **3.5 Conclusion**

The proposed action will adversely affect the EFH for chinook and coho salmon in the action area.

### **3.6 EFH Conservation Recommendations**

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. NOAA Fisheries recommends the Corps implement the conservation recommendations and terms and conditions in the ESA consultation.

### **3.7 Statutory Response Requirement**

Please note that the MSA (section 305(b)) and 50 CFR 600.920G) requires the Federal agency to provide a written response to NOAA Fisheries after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse effects of the activity on EFH. If the response is inconsistent with a conservation recommendation from NOAA Fisheries, the agency must explain its reasons for not following the recommendation.

### **3.8 Supplemental Consultation**

The Corps must reinitiate EFH consultation with NOAA Fisheries if either action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920).

#### 4. LITERATURE CITED

Section 7(a)(2) of the ESA requires biological opinions to be based on the best scientific and commercial data available. This section identifies the data used in developing this Opinion.

Beamer, E.M., R.A. Henderson. 1998. Juvenile salmonid use of natural and hydromodified streambank habitat in the mainstem Skagit River, northwest Washington. Corps of Engineers, Seattle District. Seattle Washington, September 1998.

Berg, L. and T.G. Northcote. 1985. Changes In territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Berg, L. 1983. Effects of short term exposure to suspended sediments on the behavior of juvenile coho salmon. Mater's Thesis. University of British Columbia, Vancouver, B.C. Canada.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W.R. Meehan, ed. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19:83-138.

Bolton, S. and J. Shellberg. 2001. Ecological issues in floodplains and riparian corridors. White paper: aquatic habitat guidelines. Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. Olympia, Washington.

Botkin, D., K. Cummins, T. Dunne, H. Regier, M. Sobel, and L. Talbot. 1995. Status and future of salmon of western Oregon and northern California: findings and options. Report #8. The Center for the Study of the Environment, Santa Barbara, California.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest ecosystem management: an ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team. U.S. Government Printing Office 1993-793-071. U.S. Government Printing Office for the U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Land Management, and National Park Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service; and the U.S. Environmental Protection Agency.

Gammon, J.R. 1970. The effects of inorganic sediment on stream biota. Environmental Protection Agency, Water Quality Office, water pollution control research series 18050DWC12/70.

- Gregory, R.S., and C.D. Levings. 1998. Turbidity reduces predation on migrating juvenile Pacific salmon. *Transactions of the American Fisheries Society* 127: 275-285.
- Jacobs, S., J. Firman, and G. Susac. 2001. Status of Oregon coastal stocks of anadromous salmonids, 1999-2000: Monitoring Program Report Number OPSW-ODFW-2001-3, Oregon Department of Fish and Wildlife, Portland, Oregon.
- Li, H. W.; C. B. Schreck, and R. A. Tubb. 1984. Comparison of habitats near spur dikes, continuous revetments, and natural banks for larval, juvenile, and adult fishes of the Willamette River. Oregon Cooperative Fishery Research Unit Department of Fisheries and Wildlife, Oregon State University. Water Resources Research Institute, Oregon State University, Corvallis, Oregon 1984.
- Lichtowich, J. A. 1989. Habitat alteration and changes in abundance of coho (*Oncorhynchus kisutch*) and chinook (*Oncorhynchus tshawytscha*) salmon in Oregon's coastal streams, p. 92-99. In C. D. Levings, L. B. Holtby, and M. A. Henderson (editors), *Proceedings of the National Workshop on Effects of Habitat Alteration on Salmonid Stocks*, May 6-8, 1987, Nanaimo, B.C. *Can. Spec. Publ. Fish. Aquat. Sci.* 105.
- Lloyd, D.S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. *North American Journal of Fisheries Management* 7:34-45.
- Lloyd, D.S., J.P. Koenings, and J.D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. *North American Journal of Fisheries Management* 7:18-33.
- Michny, F., and R. Deibel. 1986. Sacramento River Chico Landing to Red Bluff project 1985 juvenile salmon study. US Fish and Wildlife Service Sacramento, California. US Army Corps of Engineers.
- National Marine Fisheries Service (NOAA Fisheries). 1999. Habitat conservation and protected resources divisions. The Habitat Approach. Implementation of section 7 of the Endangered Species Act for action affecting the habitat of Pacific anadromous salmonids.
- National Marine Fisheries Service (NOAA Fisheries). 1998. Endangered Species Act - Section 7 consultation supplemental biological opinion and incidental take statement to the Pacific coast salmon plan and amendment 13 to the plan.
- Neff, J.M. 1985. Polycyclic aromatic hydrocarbons. Pages 416-454 in G.M. Rand and S.R. Petrocelli. *Fundamentals of aquatic toxicology*, Hemisphere Publishing, Washington, D.C.
- Newcombe, C. P., and D. D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. *North American Journal of Fisheries Management* 11: 72-82.



- Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oregon Department of Fish and Wildlife, Research Development Section and Ocean Salmon Management, 83 p. Oregon Department of Fish and Wildlife, P.O. Box 59, Portland.
- Noggle, C.C. 1978. Behavioral, physiological and lethal effects of suspended sediment on juvenile salmonids. [Thesis] Seattle: University of Washington.
- North, J. A., L. C. Burner, B. S. Cunningham, R. A. Farr, T. A. Friesen, J. C. Harrington, H. K. Takata, and D. L. Ward. 2002. Relationships Between Bank Treatment/Near Shore Development and Anadromous/Resident Fish in the Lower Willamette River. Annual Progress Report May 2000 and June 2001. Oregon Department of Fish and Wildlife. City of Portland-Bureau of Environmental Services. Portland, Oregon.
- Oregon Coastal Salmon Restoration Initiative. March 10, 1997. State of Oregon, Salem.
- ODAS (Oregon Department of Administrative Services). 1999. Oregon economic and revenue forecast. Vol. XIX. No. 2. Office of Economic analysis, Salem.
- ODFW (Oregon Department of Fish and Wildlife). 2002. Estimated coho spawner abundance. 2001 spawning season. ODFW website.
- ODFW (Oregon Department of Fish and Wildlife). 2000. Memorandum from Patty Snow: Updated in-water timing guidelines.
- ODFW (Oregon Department of Fish and Wildlife). 2000. Guidelines for timing of in-water work to protect fish and wildlife resources. 12 p.  
([http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600\\_inwtrguide.pdf](http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600_inwtrguide.pdf)).
- Peters, R. J., B. R. Missildine, and D. L. Low. 1998. Seasonal fish densities near river banks treated with various stabilization methods. US Fish and Wildlife Service, Lacey, Washington.
- PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Portland, Oregon.
- PSU (Portland State University). 1999. Nehalem River watershed assessment.
- Redding, J. M., C. B. Schreck, and F. H. Everest. 1987. Physiological effects on coho salmon and steelhead of exposure to suspended solids. Transactions of the American Fisheries Society 116:737-744.

- Rodgers, J.D. 2001. Monitoring of the abundance of juvenile salmonids in Oregon coastal streams. Monitoring program report number OPSW-ODFW-2001-1, Oregon Department of Fish and Wildlife, Portland, Oregon.
- Schaffter, R. G., P. A. Jones, and J. G. Karlton. 1983. Sacramento River and tributaries bank protection and erosion control investigation evaluation of impacts on fisheries. California Department of Fish and Game. US Army Corps of Engineers DACWO 5-80-C-0110. Sacramento, California. 1983.
- Servizi, J. A., and Martens, D. W. 1991. Effects of temperature, season, and fish size on Acute lethality of suspended sediments to coho salmon. Canadian Journal of Fisheries and Aquatic Sciences 49:1389-1395.
- Sheahan, J. 2002. North coast basin habitat use by salmonid species. Table 7 in: Draft North coast subbasins total maximum daily load. Oregon Department of Environmental Quality, Portland. 436 p. November.
- Sigler, J.W. 1988. Effects of chronic turbidity on anadromous salmonids: recent studies and assessment techniques perspective. Pages 26-37 in C. A. Simenstad (ed.). Effects of dredging on anadromous Pacific coast fishes. Washington Sea Grant Program. Washington State University. Seattle, Washington.
- Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelheads and coho salmon. Transactions of the American Fisheries Society 113:142-150. 1984.
- Spence, B.C., G.A. Lomnický, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon. 356 p. Available from the National Marine Fisheries Service, Portland, Oregon.
- Steelquist, R. 1992. Field guide to the Pacific salmon. Sasquatch Books. Seattle, WA.
- USACE (United States Army Corps of Engineers). 1977. Nehalem wetlands Review: A comprehensive assessment of the Nehalem Bay and River (Oregon). U.S. Army Engineer District, Portland, Oregon.
- Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-24, 258 p.